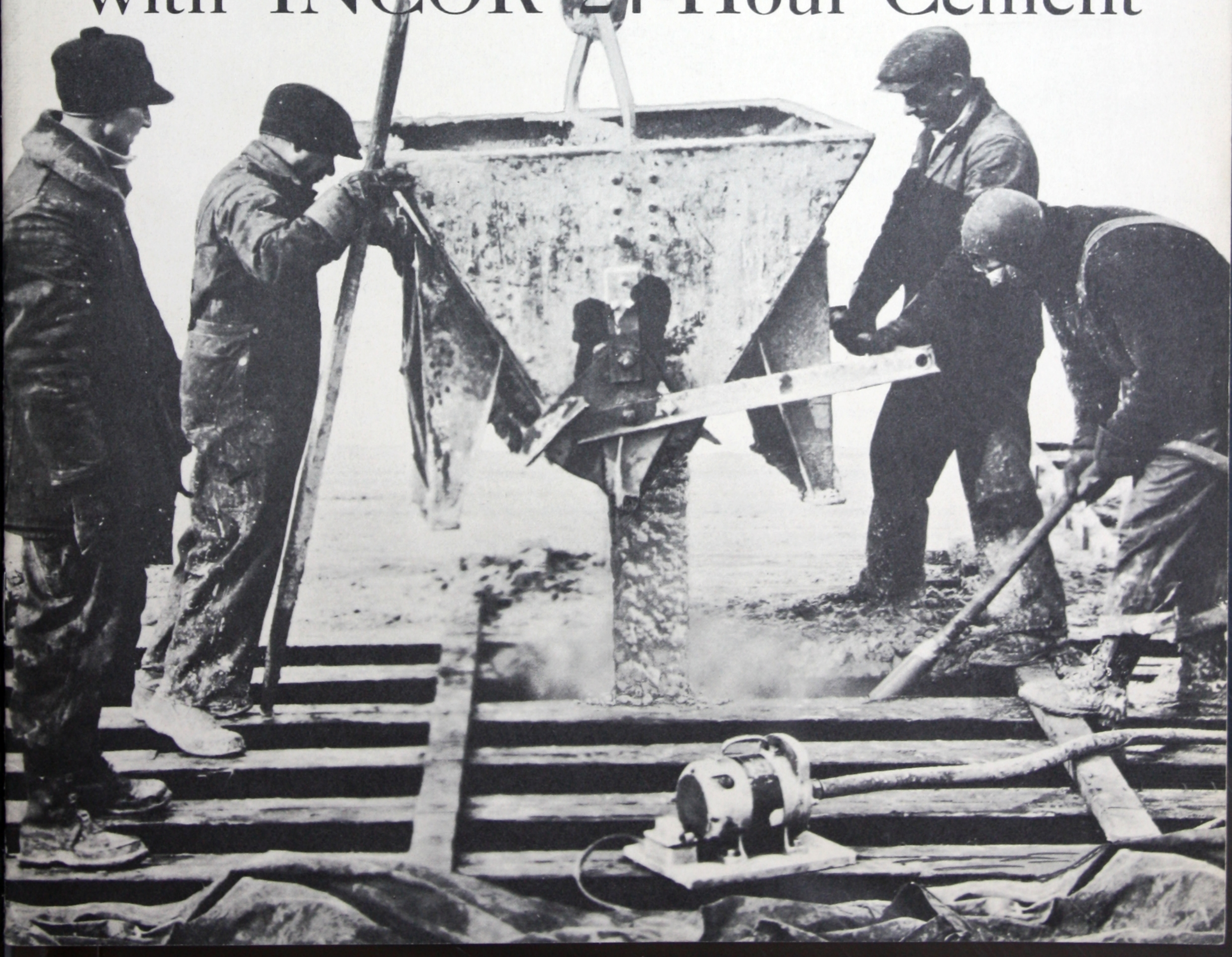
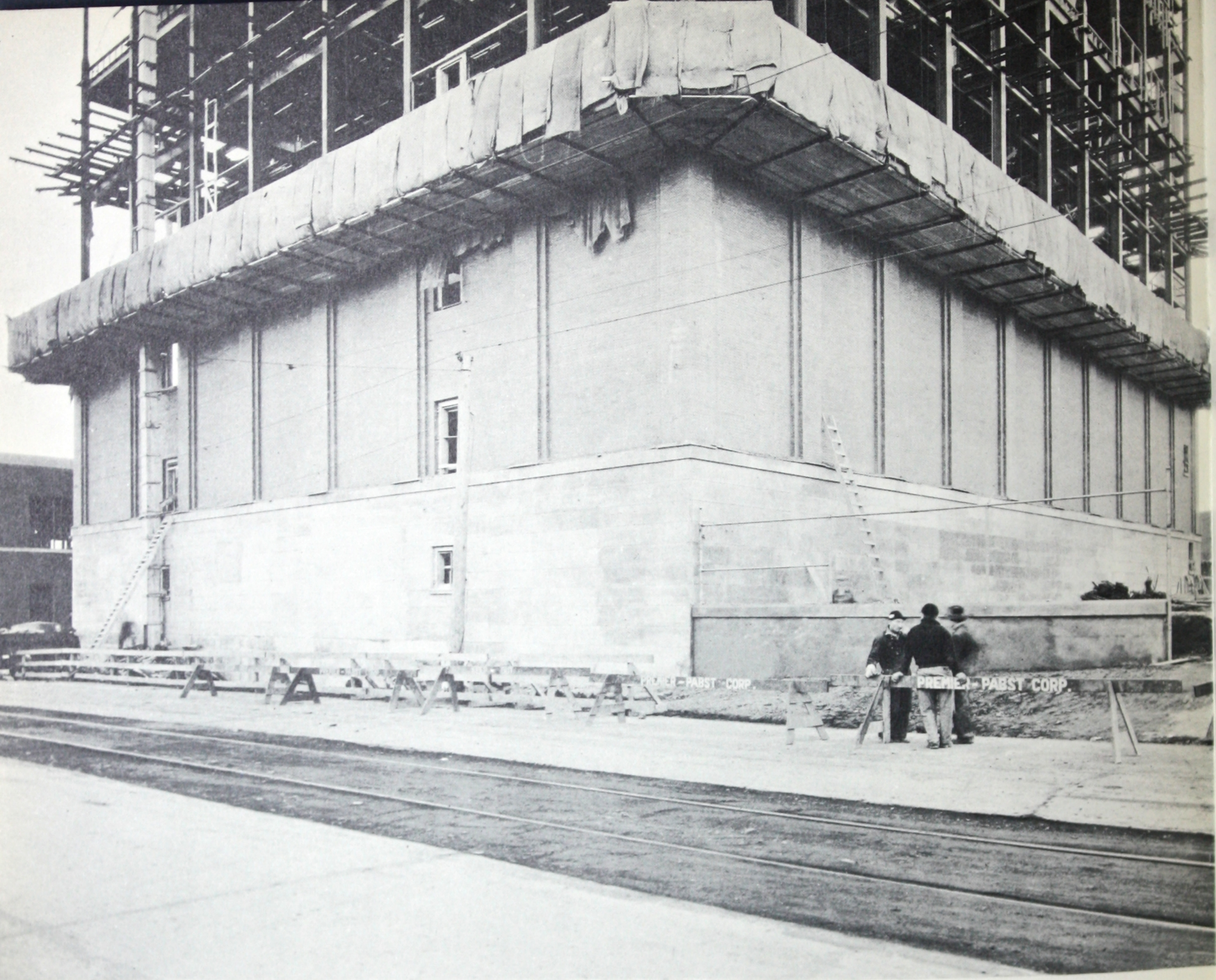
Winter

CONSTRUCTION

with 'INCOR' 24-Hour Cement





BETTER CEMENT MAKES BETTER CONCRETE. Through a basic improvement in process of manufacture, 'Incor' 24-Hour Cement cures or hardens five times as fast as ordinary Portland cement. That means dependable high early strengths, so important in Winter concreting, and it also means denser, more watertight concrete—dual advantages clearly demonstrated in construction of two Premier-Pabst Brewery buildings in Peoria Heights, Ill. 'Incor', used in foundation walls, showed much higher strengths, at no greater expense, than ordinary Portland cement plus waterproofing admixture. At 48 hours, 'Incor' was as watertight as ordinary cement at 10 days. ¶Also used in superstructure, 'Incor'* materially reduced Winter-protection costs. Water and aggregates were heated; concrete, placed at 80°, was covered, and heated with salamanders for only 48 hours. Concreting was continuous, even at sub-zero temperatures—December 27th's thermometer reading 4° below zero at 8 a.m., with 7° below the preceding night. Floor forms were stripped in 4 days, wall forms in 2 days. Completion was advanced at least one month; plant operation started that much sooner.

*Reg. U. S. Pat. Off.

Winter Construction

Precautions needed in cool, cold and sub-freezing weather . . . How 'Incor' Cement reduces Winter costs, and makes Summer schedules possible in cold weather.

FOREWORD

In Winter, more than at any other season of the year, it pays to develop high concrete strengths at early periods. Heat-curing, form requirements and frost hazard are thereby reduced to a minimum—lower costs and rapid construction progress result.

Concrete hardens through a chemical reaction between Portland cement and water. At 70° or above, this reaction takes place normally and thoroughly. As the concrete temperature falls, the reaction is retarded; at or about freezing, it practically stops.

Strength development depends upon concrete temperature and not upon that of air. To overcome the effect of low air temperatures, it is necessary to heat the materials and retain that heat until the concrete has cured or hardened sufficiently to 'go it alone.' *Therefore, the quicker concrete hardens, the less time and expense are required to maintain heat artificially.*

Through a basic improvement in the process of manufacture, 'Incor' 24-Hour Cement cures or hardens 5 times as fast as ordinary Portland cement. Result—

1. Heat-protection costs are 60 to 70 per cent lower;
2. Cold-wave hazard becomes a matter of hours instead of days;
3. Form re-use is speeded up—one set does the work of several;
4. Summer schedules are maintained even in dead of Winter—labor lay-offs minimized.

The dollars-and-cents economies introduced by 'Incor's high early strength make year-around construction—talked about for a generation—a thoroughly practical reality.

WINTER-PLACED CONCRETE

CONCRETE temperatures are the controlling factor in successful Winter work; air temperatures are important only as they affect the initial heating of the concrete materials and the protection required against heat loss. Results depend upon how effectively concrete temperatures are maintained and upon the time required by the cement to provide service strength.

Heat-protection methods depend upon air tempertures. For simplicity, sub-normal air temperatures are classified on the basis of mean temperatures from sunset to sunrise, as follows:

1. Cool—night temperatures average 50°
2. Cold—night temperatures average 33°
3. Sub-freezing—night temperatures average 16°

Table I gives suggested periods of heat curing and protection methods for various types of structure, for these three typical exposure conditions. Fig. 1 shows strengths obtained with 'Incor' concrete of various water contents, cured moist at 70°. Figs. 2 and 3 indicate strengths for concrete cured moist at 70° for 1 and 3 days and then exposed to temperatures of 50°, 33° and 16°. While field conditions vary widely, these recommendations and data provide a basis for sound construction programs.

Cool-Weather Concreting

In late Spring and early Fall, unheated concrete is cool when placed; if unprotected, it loses heat and hardens but little during the first night,—the critical period for early strengths. Some precautions should be taken; usually it is sufficient to heat the mixing water and promptly protect the placed concrete.

A 5° rise in temperature of mixing water produces a rise of approximately 1° in concrete temperature. Thus, if concrete temperature is to be raised 20°, water temperature should be raised 100°.

For high early strengths, 'Incor' 24-Hour Cement should be used, with concrete temperatures and curing conditions as indicated in Table I.

Unheated 'Incor' concrete (mixed with 4½ to 6 gals. of water), deposited at 50°, if promptly protected, attains service strength in from 2 to 3 days.

Cold-Weather Concreting

When mean night temperatures fall below 45°, additional precautions are necessary. Both mixing water and aggregates should be heated, the amount of heat

TABLE I. MINIMUM HEAT PROTECTION REQUIREMENTS

These recommendations are based upon use of high-early-strength cement meeting A.S.T.M. Specification C74-30T. Concrete temperatures at mixer presuppose minimum heat loss during transportation and placing, as well as prompt covering. Concrete should be kept moist and at temperature of not less than 70° for periods indicated. The time range given under 'Hours heat-curing' makes allowance for average air temperatures which are above or below those given in the Table.

CLASS OF STRUCTURE	WATER PER SACK OF CEMENT Includes Moisture in Aggregates	CONCRETE TEMPERATURES AT MIXER AND HEAT-CURING PERIODS — AVERAGE AIR TEMPERATURE BETWEEN SUNSET AND SUNRISE						SUGGESTED PROTECTION METHODS — AVERAGE AIR TEMPERATURE		
		*50 Degrees		33 Degrees		16 Degrees				
		Concrete temperature	Hours heat-curing	Concrete temperature	Hours heat-curing	Concrete temperature	Hours heat-curing	50 Degrees	33 Degrees	16 Degrees
ROADS, STREETS, SIDEWALKS	4½ gal.	70°	12	80°	24-36	90°	48-72	Heat mixing water. Cover with wet burlap and 6" straw.	Cover sub-grade with straw. Heat both water and aggregates. Cover with wet burlap and 9" straw.	Cover sub-grade with straw. Heat both water and aggregates. Cover with wet burlap and 12" straw. Cover straw with canvas.
	6 gal.	70°	18	80°	36-48	90°	60-72			
GIRDERS, BEAMS, COLUMNS, THIN WALLS, OTHER EXPOSED WORK ABOVE GRADE	4½ gal.	65°	8	75°	24-30	90°	36-60	Heat mixing water. Canvas curtains, cover exposed horizontal surfaces with straw.	Heat both water and aggregates. Wind-tight enclosures. Supply heat.	Heat both water and aggregates. Wind-tight enclosures. Supply heat.
	6 gal.	65°	12	75°	36-48	90°	48-72			
PILES, PIPES AND PRODUCTS, CAST IN OPEN	4½ gal.	70°	8	80°	18	90°	24	Heat mixing water. Cover with wet burlap. Protect against heat loss.	Heat both water and aggregates. Provide heated enclosures.	Heat both water and aggregates. Provide heated enclosures.
	6 gal.	70°	12	80°	24	90°	30			
DAMS, RETAINING WALLS, PIERS, FOUNDATIONS, ABUTMENTS, OTHER LARGE MASSES	4½ gal.	60°	12	70°	18-24	80°	24-48	Heat mixing water. Cover exposed surfaces with canvas.	Heat both water and aggregates. Cover with straw and canvas.	Heat both water and aggregates. Cover where possible with straw and canvas. Supply heat.
	6 gal.	60°	18	70°	24-36	80°	48-72			
	9 gal.	60°	24	70°	36-48	80°	72			

***NOTE: When 'Incor' is used at 50° to avoid the cost of heating materials, the unheated concrete should be covered promptly and kept covered 2 to 3 days.**

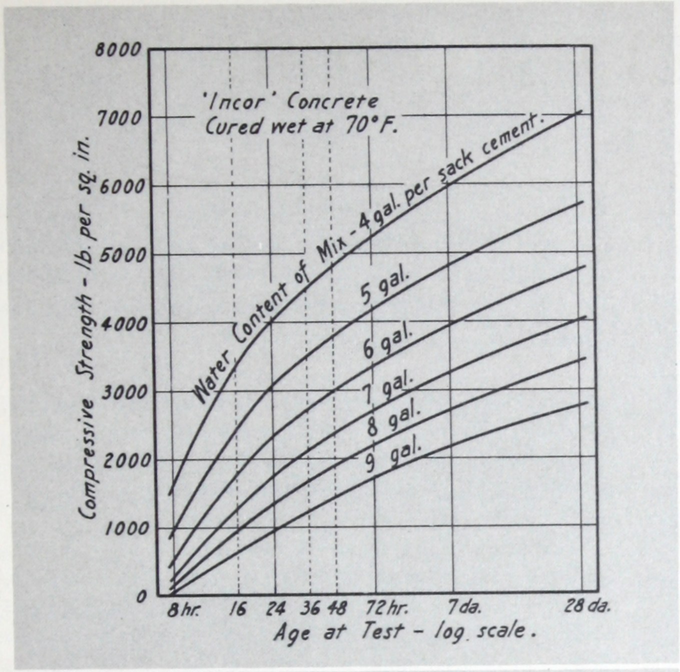


Fig. 1: Age-strength relation for 'Incor' concrete. The strengths shown are based on tests of 6 x 12-in. cylinders, cured moist at 70° until tested. Under job conditions make allowance for variations in temperature and curing.

depending upon conditions. In all cases, be on the safe side—don't take chances.

Water may be heated up to 150°—aggregates heated as required. If water is heated above 150° (in no case above 180°), put water and aggregates into the mixer first. Then, after the drum revolves a few times, add the cement. In this way, rapid stiffening of the mix should be avoided.

Flat work, such as pavements and large masses, should be promptly and effectively covered. For structures above ground, apply heat inside the enclosure, preferably exhaust steam. Exposed surfaces, particularly angles, pilasters, lintels, buttresses, etc., should receive special attention.

Under cold weather conditions, it does not pay to maintain temperatures lower than 70° during curing; it is cheaper to maintain adequate heat for one day than inadequate heat for several days. If heat-protection is required, you might as well cash in on the ability of 'Incor' to harden rapidly and produce high early strengths.

In Sub-Freezing Weather

When mean temperatures between sunset and sunrise are below freezing, more elaborate precautions are necessary: (1) High initial concrete temperatures are required; (2) more efficient protection is necessary to avoid heat losses; (3) higher concrete strengths must be secured to withstand the effect of freezing after heat-curing stops.

Nowhere else in the entire range of construction do sound methods and careful workmanship pay higher dividends than in sub-freezing concrete operations. Here, too, the advantages of 'Incor' are most clearly apparent. By providing 'Incor' with the curing conditions recommended in Table I, costly heat protection will be reduced to a minimum and sound, lasting work assured.

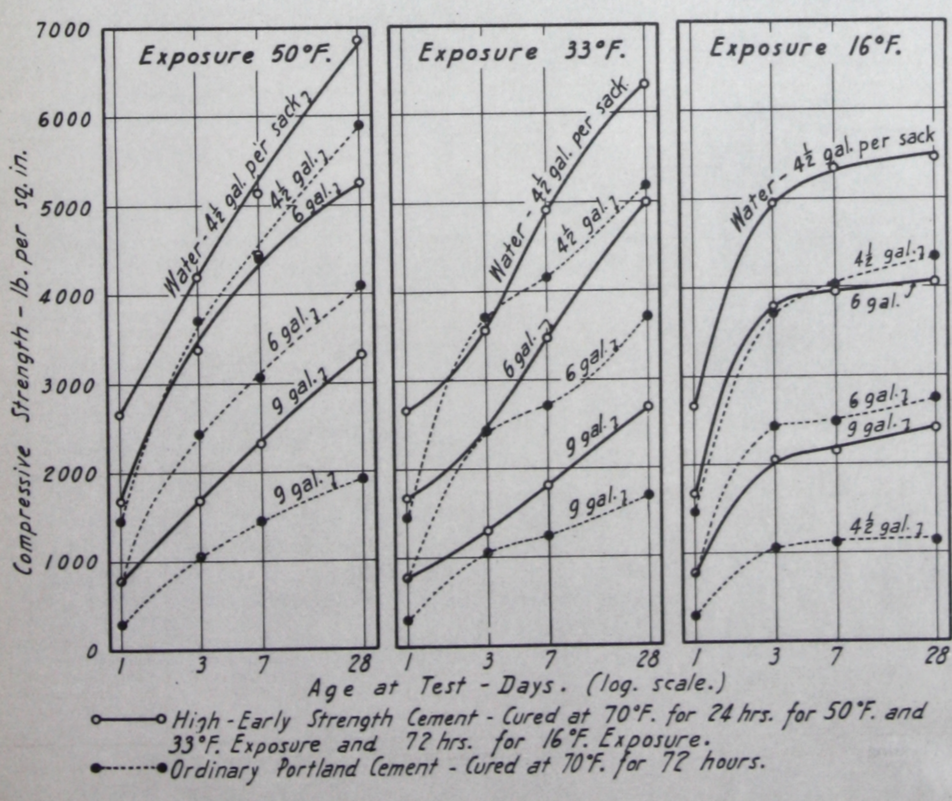


Fig. 2: Strength values shown in these diagrams indicate results which may be expected under various curing conditions, using water contents of 4½, 6 and 9 gals. After 1 day's heat-curing, strengths with high-early-strength cement for 50° and 33° exposure are higher at all ages than those of ordinary Portland cement heat-cured 3 days. At 16°, 36 to 48 hours' heat-curing with high-early-strength cement will produce about the same strengths as 5 days' heat-curing with ordinary cement. Using high-early-strength cement, service strengths will be obtained in from 1 to 3 days, according to the water content used. (After data from "Temperature Effects on Compressive Strength of Concrete," by A. G. Timms and N. H. Withey; Proc., Amer. Concrete Inst., Vol. 30, p. 159.)

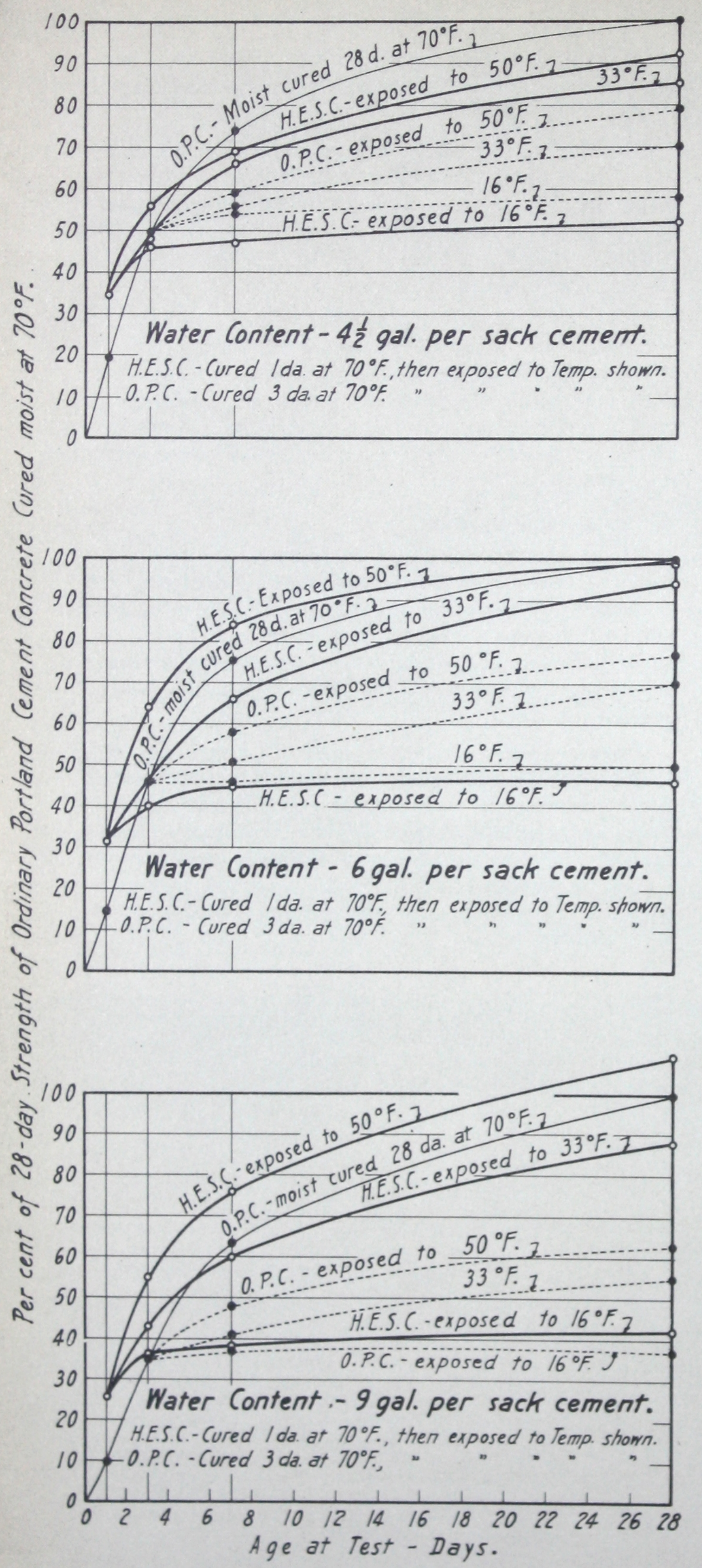


Fig. 3: Relative strength values of high-early-strength cement cured at 70° for periods indicated, then exposed to sub-normal temperatures, are shown as a ratio of the 28-day strength of ordinary Portland cement, cured moist at 70°.
(After data from "Temperature Effects on Compressive Strength of Concrete," by A. G. Timms and N. H. Withey; Proc., Amer. Concrete Inst., Vol. 30, p. 159.)

SIMPLE ESSENTIALS

FOLLOWING are essentials of successful Winter concreting methods. Applied in the light of the practical requirements of each job—and with a weather eye always on the thermometer—they lead to satisfactory results.

1. ***Quantity of Mixing Water:*** Follow sound concrete practice; use no more water than required by placing conditions. This is even more important in cold weather than at normal temperatures.

2. ***Heated Mixing Water:*** Water may be heated by exhaust steam released at the bottom of the tank, by steam coils, or by direct-fired boilers. It pays to have more than enough hot water; only a large reservoir can deliver water at uniform temperature.

A low-pressure boiler of ample size (mounted on skids if the mixer is moving), discharging into the measuring tank of the mixer, is desirable. Under severe conditions, it pays to protect the mixer tank. Excessive water temperatures should be avoided; 150° is a good working limit—never exceed 180°.

3. ***Heated Aggregates:*** Aggregates should be heated with care; dry heat and excessive temperatures should be avoided. The soundest method is to store the aggregate in compact piles, underlaid with perforated low-pressure steam pipes. Given sufficient time, the exhaust steam will raise aggregate temperature uniformly and drive out all frost. Heat all parts of the pile thoroughly; under severe conditions cover stock piles.

Be sure aggregates are fully heated when withdrawn from stock piles—systematic handling will prevent use of cold materials and minimize heat protection.

4. ***Thorough Mixing:*** It pays to mix thoroughly; additional mixing permits the use of less water for a given workability, and that means increased concrete strengths.

5. ***Prompt Placing:*** Mix the concrete as close to point of deposit as possible. Transportation from mixer to work should be studied. Move the concrete no further than necessary—avoid delays—guard against heat loss en route.

Spread, compact and finish concrete promptly—then apply protection immediately. Early strengths depend upon the speed with which concrete is placed and protected—heat losses are highest during the first hour after placing.

6. ***Heat of Hydration:*** All concrete generates heat, due to the hardening action of the cement; some cements generate this heat rapidly, others slowly. Special low-heat cements should not be used in cold weather, as their rate of hardening is slow.

This heat, if held in the concrete, greatly assists hardening. As 'Incor' develops much of its heat of hydration at early periods, prompt covering will retain this heat as well as that contained in mixing water and aggregates. This is more important and pays larger dividends with 'Incor' than with ordinary Portland cement.

In cool weather (45° or above), 'Incor's heat of hydration may be utilized to reduce or eliminate the need for applied heat; in cold and in freezing weather it contributes to the heat retained in the concrete and helps offset losses due to radiation.

7. ***Protection:*** Protection against heat losses should be adequate to maintain the desired concrete temperature at all points in the structure for the full time required.

Methods vary with type of structure and exposure. Wet burlap, heavy beds of straw—plus canvas coverings in cold, windy weather—are used effectively to protect mass structures, even highway pavements.

Canvas enclosures containing heating apparatus, such as perforated steam pipes or salamanders, are used for bridges, buildings and similar structures.

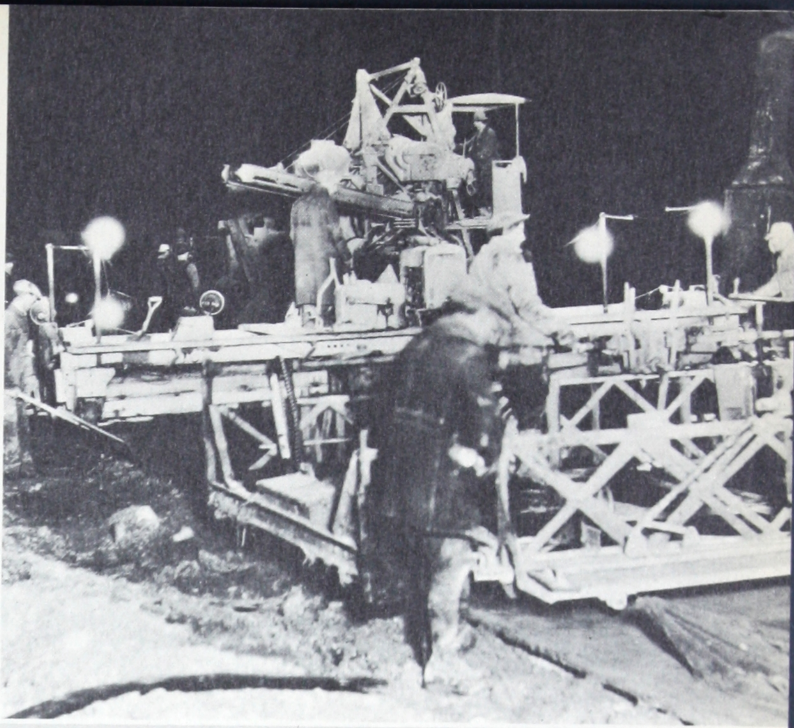
Costly wood housings are unnecessary when 'Incor' is used—because the period of heat-curing is so short, even under severe conditions.

Care should be exercised to protect exposed portions of small or moderate mass and exterior vertical surfaces. Pilasters, especially at the base, lintels, buttresses and other exposed members, require extra protection and their own sources of heat in freezing weather.

Don't skimp on heat. Remember adequate temperatures maintained for a full day, are better than inadequate temperatures for several days. Guard against temperature drops—the low point before dawn and the unexpected change in weather.

8. ***Curing:*** Concrete has to be kept moist in order to cure—in Winter as well as Summer. If heat is supplied by wet steam, sufficient curing moisture is usually available. If dry heat is used (salamanders, etc.), be careful to avoid drying out. Dried-out concrete will not gain in strength as it should. If air is dry, water should be applied to the concrete.

9. ***Chemicals or Accelerators:*** Salts to lower the freezing point and chemicals designed to raise temperatures are not recommended. Calcium chloride can



CONCRETE AT ZERO. Resurfacing 1½-mile section of Hamilton-Eaton Road, in Southwestern Ohio; first concrete poured December 5th, last December 30th. Finished grading was carried only 500 ft. ahead of mixer, subgrade straw-covered at night, thawed out in morning with hot water and steam. Water heated by boiler mounted on skids, drawn along by mixer. Forms were pre-heated with steam and hot water; concrete placed on grade at 70°, covered with wet burlap and 10″ of straw, protected until 600 lb. beam-strength permitted opening. Beams, cores and cylinders from each day's pour were cured with pavement. 36 beams averaged 72-hour opening strengths, with some 48 hours. Temperatures reached sub-zero, but concrete was placed continuously. December 26th night temperatures dropped to 7° below zero; next morning temperature under covering at concrete surface was 44°, air temperature 6° above zero. Cores of 'Incor' concrete cut from that day's run, developed 24-hour compressive strength 1509 lbs., 48-hour 2610 lbs.

48-HOUR PAVEMENT OPENING IN WINTER. Philadelphia street paving used to stop in November; 'Incor' changed the practice by eliminating the cause. Illustrated above is Chestnut Street, between 30th Street and Woodland Avenue, part of U. S. Route 1, 47,000 daily traffic count. Repaving started November 27th. Air temperatures averaging 45° were offset by use of 'Incor' and effective Winter methods—heated aggregates, placed concrete promptly covered with burlap and straw. Specifications required minimum 50° maintained concrete temperature, until 500-lb. beam strengths for opening were secured. 'Incor' concrete beams, made up daily, two each in morning and afternoon, protected with the slab, showed 549 lbs. average flexural strength in 48 hours. With 'Incor', operations are maintained at normal rates—paving laid does not diminish as nights grow cold. Finishing overtime is avoided; contractor gains through maintained production—the public through earlier completion.

be used with 'Incor' to increase rate of hardening, but should not exceed 2% by weight of the cement. More dependable results are obtained at lower cost by heating materials.

10. ***Don't Take Chances:*** It pays to be on the safe side; don't take chances simply because you may know of successful concreting in cold weather without proper protection. It is true that frozen concrete has hardened after thawing; but that is sheer good luck—not good management.

When 'Incor' is used, the additional expense necessary to make certain that cold weather does not affect the strength of the concrete is so small that it doesn't pay to neglect the simple precautionary measures.

Note: *Test specimens, due to their small mass, invariably give strengths in cold weather lower than that of concrete in the structure. Great care must be exercised to cure the specimens at temperatures comparable to those in the structure itself.*

'Incor' is the result of a basic advance in the process of manufacturing Portland cement. Its slightly higher first cost is more than offset in most cases by the clear-cut savings it produces. In sub-freezing weather, for example, the saving in coke alone is usually more than the nominal cost differential—the other savings are so much velvet. It means a lot to be able to carry construction ahead on Summer schedules in dead of Winter—and that is precisely what 'Incor' makes possible.

HIGHWAYS

HIGHWAY BUILDING in northern Winters is by no means the impractical dream many have considered it to be; a great deal of work on a highway project can be carried on profitably any day men can work in the open.

The use of 'Incor' Cement, plus reasonable protection, makes possible year-around highway construction. Excavation and bridge building can be carried on throughout the Winter, and paving continued until deep frosts are encountered. The paving season is materially lengthened, making it possible to close gaps and complete highway sections which might otherwise lay over until Spring. Traffic is not forced to use open sub-grade; contractors receive substantial estimates.

Cool-Weather Paving

The first cool nights call for heated water and covering the concrete; the use of 'Incor' permits early opening to traffic, avoids late finishing and allows the mixer to run up to quitting time.

Heat the mixing water sufficiently to raise the concrete temperature 10° to 15°. As soon as it is deposited and finished, cover the concrete with a layer of wet burlap, followed by a 6-inch covering of straw. Pro-

PAVEMENT LAYING THROUGHOUT WINTER. The main street of Wyoming, Ohio, was repaved, 1¾ miles long, 52' wide. Heated concrete was protected with burlap and straw, placed immediately after finishing. Example: 65° concrete placed in 35° air temperature showed 60° next morning, with night air temperatures of 20° or less. Opening strengths were obtained in 48 hours. Compressive strengths of cores, cut from slab at time of test, were—1 day, 1716 lbs.; 2 days, 2858 lbs.; 3 days, 3760 lbs.; 7 days, 4630 lbs.; 1 year, 5205 lbs. For paving, 660 men were employed five months; supplementary operations—re-locating sub-structures, laying storm sewer, lowering gas main—meant employment for total of 800 men. This illustrates importance of highway employment as relief measure, made practical in coldest weather by 'Incor's dependable early strength.

REDUCED FORM AND PROTECTION COSTS IN WINTER STREET-WIDENING. To minimize frost hazard and reduce heat-curing expense, 3315 ft. of street widening, with curb and gutter, were built in Columbia, Mo., using 'Incor' 24-Hour Cement. Work started December 14th was carried on continuously until completion February 15th, providing practically uninterrupted employment for labor. Heated mixing water was used; sand was heated over old oil-drums fired with wood. Placed concrete was protected with covering of building-paper and straw. Concrete was opened to traffic in 24 to 48 hours, depending upon air temperatures, which ranged from 25° to 50°. To protect excavation from water running off the pavement, the old curb was left in place and removed as concreting advanced. Contractor estimates a saving of 50% in form expense and 30% in heat-curing cost.

'INCOR' ADVANCES VIADUCT OPENING 2 MONTHS. On State Highway 29, near Newark, N. J., an important super-highway viaduct, 1800 ft. long, consists of 30 concrete-beam spans and 9 steel-girder spans. 'Incor' cement was used on the last four steel-girder spans to speed cold-weather completion. With 'Incor', forms were stripped in 3 days instead of 14—saving 11 days on each of four spans. Without building additional forms, contractor completed job two months sooner. Tarpaulins over the deck slab retained concrete's heat; wood-burning salamanders under the span, and tarpaulins hung on windward side to shut off draught, protected concrete during the important 48-hour curing period following placement. By using 'Incor', the contractor also obtained more workable concrete with a lower water content, facilitating placement by towers and shoots.

'INCOR' SAVED 36 DAYS. To overcome cold weather hazards and shorten time traffic had to be detoured, 'Incor' 24-Hour Cement was used in building a triple box culvert and in closing pavement gaps in widening U. S. Highway No. 71 through Jackson County, Mo. 'Incor' so clearly demonstrated its advantages, that the contractor decided to use it for a culvert extension and wing-walls of a railroad overpass. When air temperature ranged from 30° to 55°, mixing water and aggregates were heated, temperatures within heated structure-enclosures maintained at 65° to 85°. Test beams of 'Incor' concrete showed 48-hour beam strengths ranging from 537 to 457 lbs. Heating costs were cut to the bone, and the entire job completed 36 days sooner than would have been possible with ordinary cement.

vide additional protection for the edges of the pavement. Handled in this manner, concrete temperatures are practically independent of air temperatures for several days.

Coverings should remain in place until concrete has developed service strength, as indicated by test specimens, or for a period of 48 hours.

By using 'Incor' under these conditions, the quantity of pavement laid each day is maintained and does not materially diminish as nights grow cooler. Excessive overtime for finishers is avoided. Benefits from the use of 'Incor' accrue to the contractor in maintained production and reduced operating costs—and to the public through earlier completion of the highway.

Cold-Weather Paving

As night temperatures drop below 45°, materials should be heated and more covering applied to the concrete. Heat materials so that concrete is deposited on the grade at a temperature in keeping with exposure, as shown in Table I. A 9-inch straw covering is recommended; this should be kept in place until opening strengths are secured, or for a period of 3 days.

Care should be exercised in the preparation of subgrade; work should be confined to a distance equivalent to one day's concreting. If frost is expected, the finished grade should be protected with a light straw covering at night. This can be sprinkled with gasoline or kerosene the following morning and burned.

By using 'Incor', work at this season adds only nominally to mixing and placing costs, and maintains production at or near Summer rates.

Sub-Freezing Paving

When night temperatures materially below freezing are expected—and particularly when they are encountered throughout the day—care must be exercised to heat materials so as to produce concrete temperatures indicated in Table I, and to protect against heat losses.

It is important that the heat in the concrete be used effectively; heat losses into the sub-grade cannot be prevented—those into the air can be minimized. In addition to wet burlap, cover the placed concrete with at least 12 inches of straw, paying particular attention to the edges; place tarpaulins on top of the straw in windy weather.

Careful attention should be paid to sub-grade; it is advisable to carry the rough grade high enough so frost penetration can be stripped off. Finish sub-grade not more than a half day's run ahead of mixer; at night, cover with straw, burn off the straw in the morning.

While 'Incor' paving has been laid and cured successfully in sub-zero air temperatures, operations usually terminate when frost enters the ground to stay. Until this occurs, all road-building operations can go forward on days when men can work in the open, projects are completed, useful employment given to labor.

BRIDGES

THERE is a sound reason for pushing bridge construction in Winter; the way is thus cleared for excavation and paving work in early Spring. The extra cost of Winter bridge building is insignificant in the total cost of a highway project, particularly when 'Incor' is used.

Concrete of high workability is necessary for bridge construction because it must be deposited in forms and around closely-spaced reinforcing steel. Do not secure this workability by additional mixing water; this practice is even more harmful in Winter than in Summer.

If cement and aggregates are carefully proportioned, workability can be obtained without adding more than 6½ gals. of water per sack of cement. More water retards hardening, reduces strengths, and increases the period of heat protection.

In Fall and Spring, when nights are cool, 'Incor' should be used and mixing water heated. Protect upper flat surfaces with straw covering; use curtains for railings and underside. Keep coverings in place until service strength is secured, as determined by test specimens, or in their absence, for 3 to 5 days. If enclosure is heated, maintain 70° during the first night, or from 12 to 15 hours. Service strength may be expected in 24 hours, permitting removal of all forms.

When minimum temperatures fall below 45°, heat both mixing water and aggregates, as suggested in Table I. To preserve heat, enclose the entire structure and maintain 70° air temperature within. In windy weather, every effort should be made to maintain 70°, as a 20° drop in temperature doubles the length of time required to gain service strength. Maintain 70° temperature until service strength is secured, as determined by test specimens, or for 2 days. Because concrete is maintained at 70°, this is shorter than the period suggested for Fall and Spring.

In sub-freezing weather, better protection is necessary; the entire structure should be enclosed with canvas or other covering. To maintain curing temperatures, more heat is required, both in the concrete, as indicated in Table I, and within the enclosure. Curing temperatures should be maintained for 2 to 3 days. If recommendations in Table I are followed, forms may be removed from 'Incor' concrete, and heat-curing stopped, after 3 days, or as indicated by test specimens stored within the enclosure.

As more heat is used, care must be exercised, particularly during high winds, to keep enough water on the surface of the concrete for curing. When heat is supplied by exhaust steam, this precaution is unnecessary; if dry heat is used, water must be added to all surfaces at frequent intervals.

BUILDINGS

WINTER construction of concrete buildings is well established; capable constructors have built up a background of successful practice even in severe weather. The cost increase of well-handled Winter building is usually offset by revenue derived from earlier use.

Here 'Incor' also produces substantial cash savings, through its ability to gain service strength rapidly, reducing heat-curing periods and making possible frequent form re-use.

Sound Winter-concreting practice must of course be observed; as temperatures fall, concrete materials should be heated. Heat losses are high, due to small masses and large exposed areas; thus, adequate heat within substantial enclosures is necessary. The higher the building, the more severe is the exposure and the more thorough the protection necessary to avoid heat loss. Follow practice indicated in Table I for satisfactory results.

Three to 4 days' heat-curing saved with 'Incor' substantially reduces the cash outlay for salamander fuel

TO REDUCE THE DANGER OF FREEZING, 'Incor' was used in the second floor and roof of the Administration Building and Hangar for the 26th Div. Mass. Natl. Guard at Boston Municipal Airport. The engineer writes: "Temperature in January was below freezing and the building site was very much exposed. To reduce the danger of freezing, I recommended that the contractor use 'Incor' Cement. Materials were heated and salamander stoves used after concrete was poured. Instead of 72 hours' protection requirement, 36 hours was substituted. Earlier removal of concrete forms saved the contractor from buying as much form lumber as would have been the case otherwise, but the real reason for using 'Incor' was to reduce freezing hazards."

and labor, which more than offsets the added cost of 'Incor.' Other economies, such as reduced form requirements and more rapid job progress, also result.

Recommendations for heat-protection are based upon the development of service strength before heat-curing is discontinued. Some constructors heat-cure only long enough to guard against frost damage; in this case forms and shoring must be kept in place longer. By adequately protecting 'Incor' concrete 2 to 3 days, forms and shores may be removed. However, safety shores are recommended, quantity depending upon structural design.

Rapid hardening of 'Incor' concrete minimizes risk of frost damage due to temperature drops and uneven heating. With careful planning, results more than equivalent to Summer work with ordinary cement are readily obtained.

SEWERS, PILING AND PRECAST PRODUCTS

Monolithic Sewer Construction

Construction of monolithic concrete sewers usually involves frequent re-use of a single form set advanced as rapidly as the concrete last placed becomes self-supporting. In Summer, with ordinary cement, two cycles of operation per week can generally be secured by shoring up the last-placed sections as forms are removed. In cold weather, this cycle requires from 1 to 2 weeks. With 'Incor', forms can be removed in from 1 to 3 days, depending upon temperature, as shown in Table I. The heating and protection problem is the same as in bridges and buildings.

'Incor's early service strength also permits prompt back-filling of trenches, reducing cost of pumping as well as safety maintenance, such as watchmen, barricades and lights. Quantity of trench sheeting and cross-bracing is greatly reduced, as is cave-in hazard.

'Incor' concrete—made of good materials, thoroughly mixed and carefully placed—produces watertight concrete in one-fifth the time required by ordinary cement. Because of 'Incor's rapid-hardening characteristics, job progress is from three to four times as fast. Payrolls, rentals and overhead on the concreting operation are reduced by 30 to 50 per cent.

Piles and Precast Products

Piles and other precast products, made of heated 'Incor' concrete and cured at 70°, can be placed in service under exactly the same conditions, both Winter and Summer. Heat-curing is readily maintained, due to the small size of units. Steam pipes laid under the casting bed, together with prompt, adequate covering, will maintain curing temperatures 70° or higher. Thus, forms can be removed in 24 hours, piles lifted from casting bed in 2 days, and driven in 3 to 5 days, in Winter the same as Summer.

Reinforced concrete pipe and other precast units, stripped of forms in 8 to 10 hours, heat-cured 8 to 30 hours, can be placed in use immediately. The small added cost of 'Incor' plus Winter protection is more than offset by uninterrupted plant operation and rapid turnover of working capital. Small working space and limited stocks are additional benefits.

PILES, POURED AT ZERO, DRIVEN IN 3 DAYS. Precast piles were used for a viaduct carrying the Erie Railroad over principal streets in Elmira, N. Y. Piles, made with 'Incor' were driven in hard soil when only 3 days old, enabling the contractor to start pouring pier foundations two months earlier, giving work to 150 more men that much sooner. The contractor saved at least 10% on overhead, and the railroad and the public profited through earlier use of the structure. After casting, piles were covered with heavy tar-paper, ends and sides protected with burlap and straw, the whole overlaid with tarpaulins and steam-cured 48 hours. Short curing period and earlier stripping enabled contractor to use half the forms required with ordinary cement. 'Incor' reduced the stock from 1500 piles to 75.

'INCOR' 24-HOUR CEMENT IS MADE BY THE PRODUCERS OF LONE STAR CEMENT:

Lone Star Cement Company Alabama	Birmingham
Lone Star Cement Company Indiana, Inc.	Indianapolis
The Lone Star Cement Company (Kansas)	Kansas City, Mo.
Lone Star Cement Company Louisiana	New Orleans
Lone Star Cement Company New York, Inc.	New York-Albany
Lone Star Cement Company Pennsylvania	New York-Nazareth
Lone Star Cement Company Texas	Dallas-Houston
Lone Star Cement Company Virginia, Inc.	Norfolk
Argentine Portland Cement Company	Buenos Aires
National Portland Cement Company (Brazil)	Rio de Janeiro
The Cuban Portland Cement Corporation	Havana
Uruguay Portland Cement Company	Montevideo

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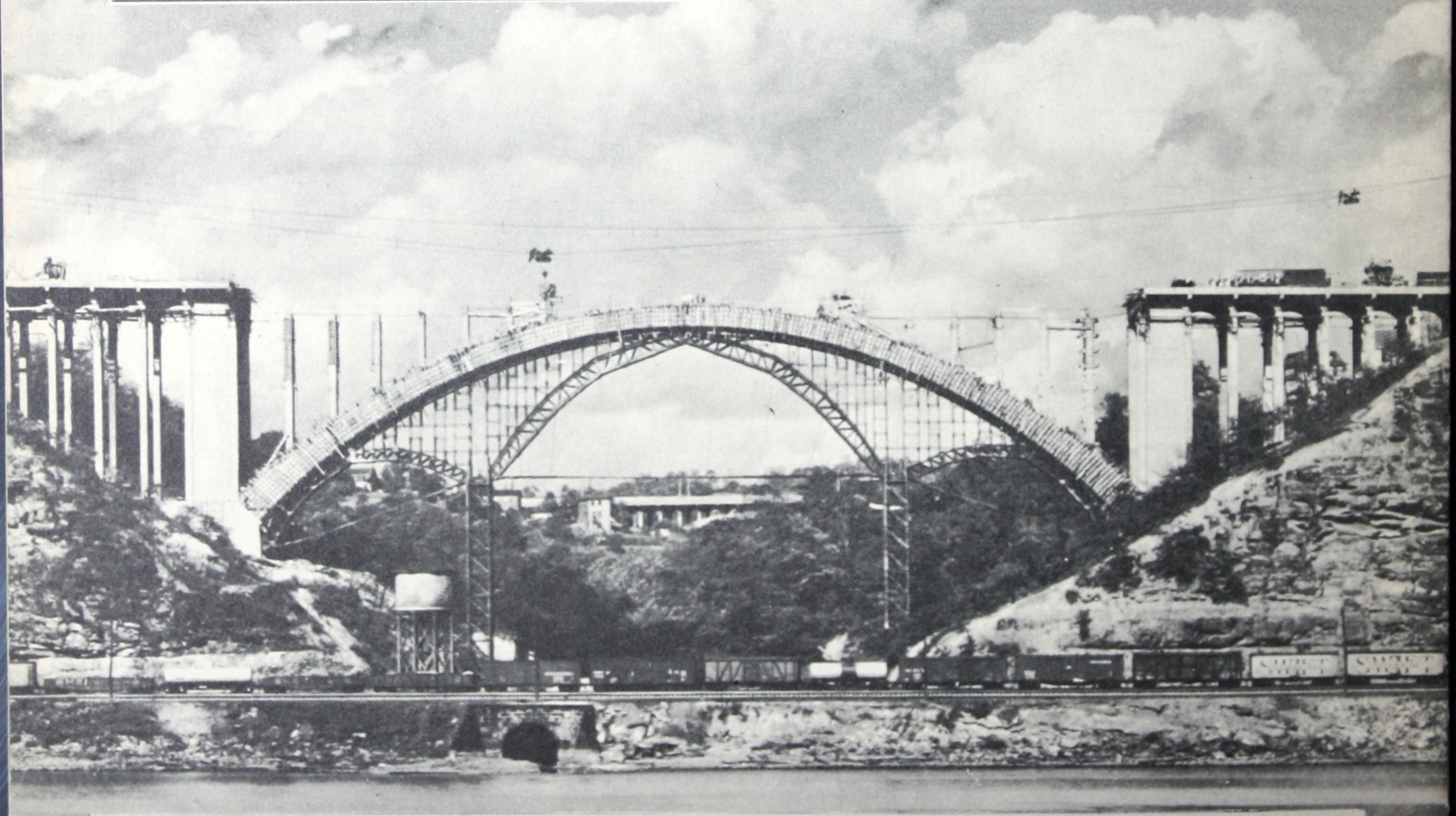

WINTER BRIDGE CONSTRUCTION SHOWS $20 SAVING FOR EACH EXTRA DOLLAR SPENT FOR 'INCOR.' The 3½ mile, four-lane boulevard along Ohio River's easterly bank near Pittsburgh, required nine bridges—five of them two-ribbed, reinforced-concrete arch structures. Contractor had two years to complete the job. Original plans, calling for Summer bridge construction, interfered with grading and paving, so all bridges were built the first Winter. Using 'Incor' in the arch ribs, work progressed at Summer schedules in dead of Winter. Centering for two ribs was used in forming the 10 ribs of the five concrete arch bridges. These two sets were combined to form the Jack's Run span shown above. Only 2 days' steam curing was required—a 5-day saving on each arch rib. Centers were struck and arch ribs made self-supporting in 4 days, saving 10 days. Work was provided for 700 men who would otherwise have been idle in Winter. The contractor completed the job seven months ahead of schedule. And his savings amounted to $20 for each additional dollar expended for 'Incor'.